High Frequency Shock During Random Vibration Testing

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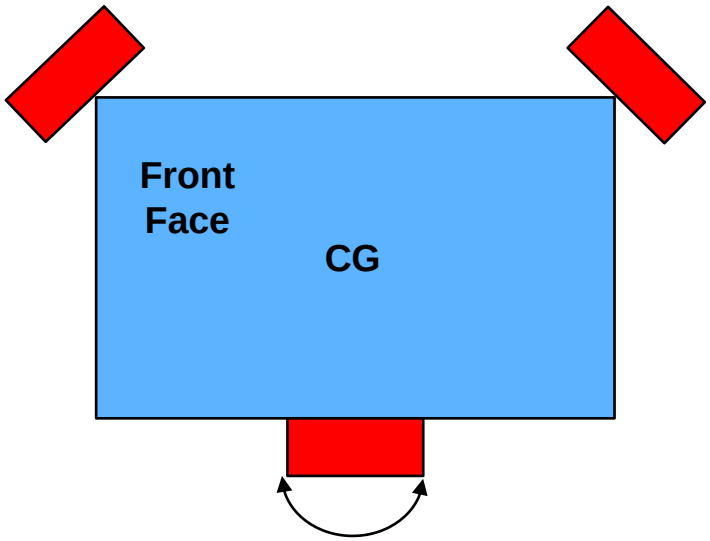
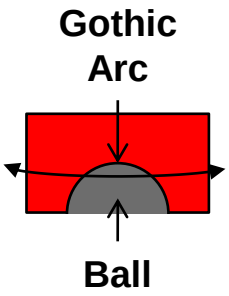
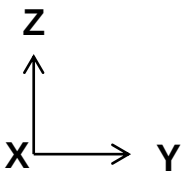
Overview

- Experienced high frequency shock during random vibration testing
- Geometry is a ball and gothic arch mount
- Incorrect stiffness of flexures in finite element model led to much higher reaction forces at interface
- What if this was not an audible event? Occurred above 2kHz, therefore outside of normal monitored range

Geometry

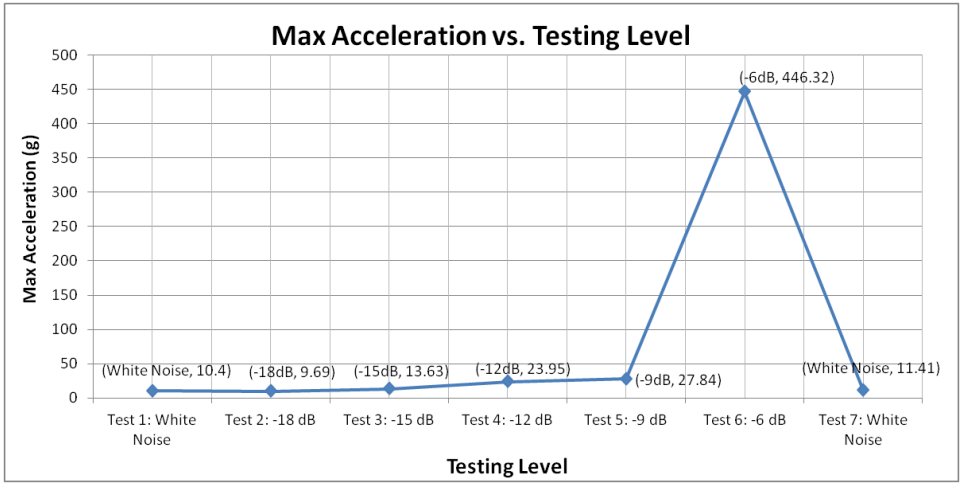




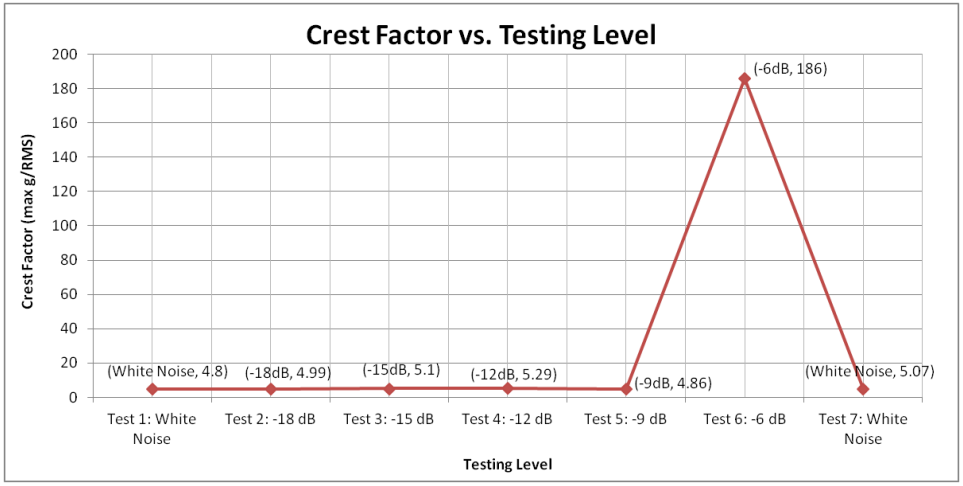


Y-axis Testing Results

- **Testing aborted at -6dB: "peening" sound heard acoustically**
- **Analysis of data shows a max 446.32g shock event at 13kHz originating from flexure (off-axis)**
  - **Corresponding natural frequency shift during -6 dB test**

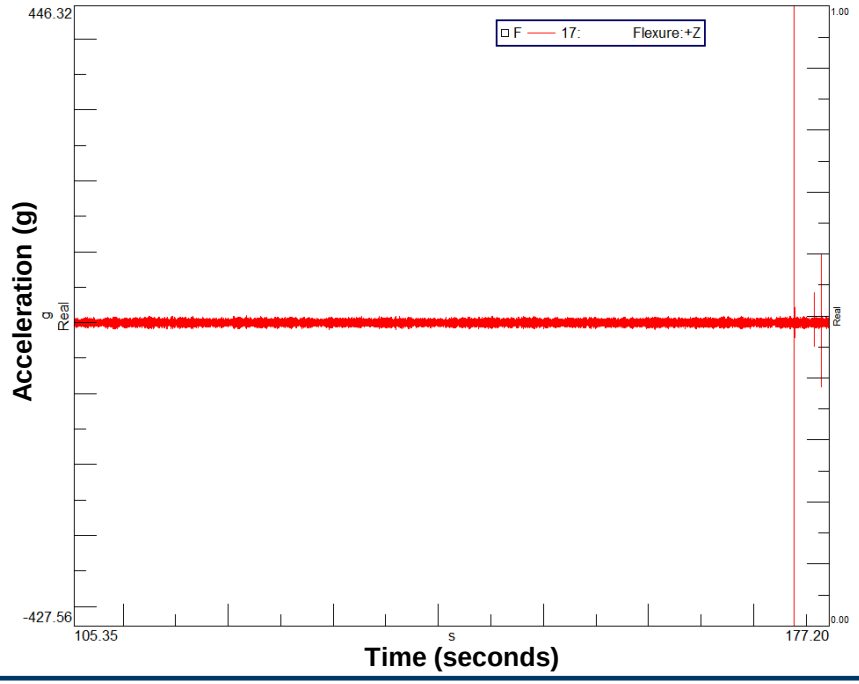


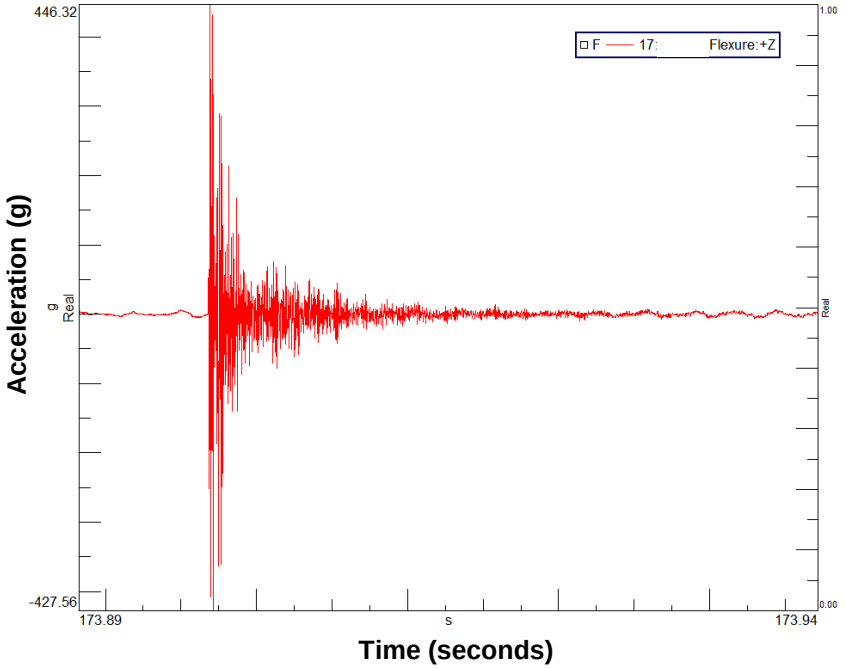
Testing Level	Natural Frequency (Hz) Ch. 17	Q Factor
Test 1: White Noise	192.5	47.97
Test 2: -18 dB	192.5	51.11
Test 3: -15 dB	192.5	50.14
Test 4: -12 dB	192.5	52.55
Test 5: -9 dB	192.5	44.99
Test 6: -6 dB	190	47.22
Test 7: White Noise	192.5	48.78



Shock Event

- **-6dB Random Input**
- **Shock origination: Bottom Flexure**

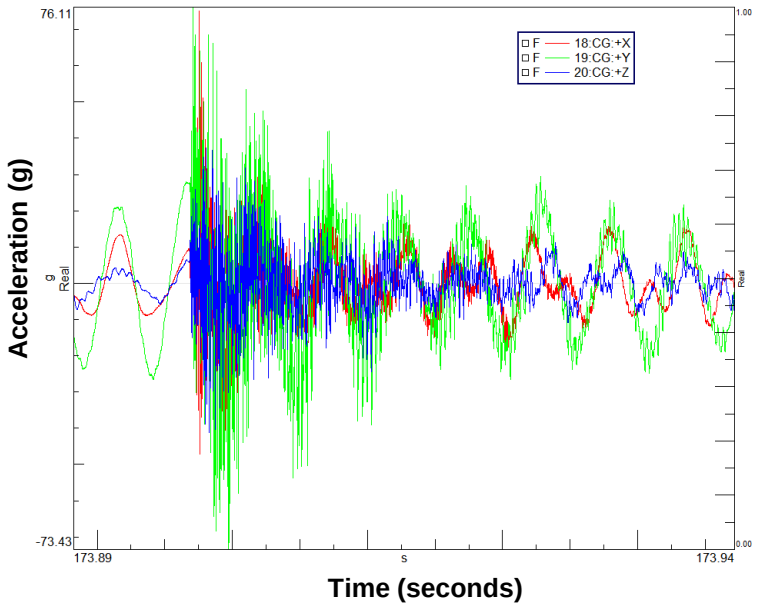




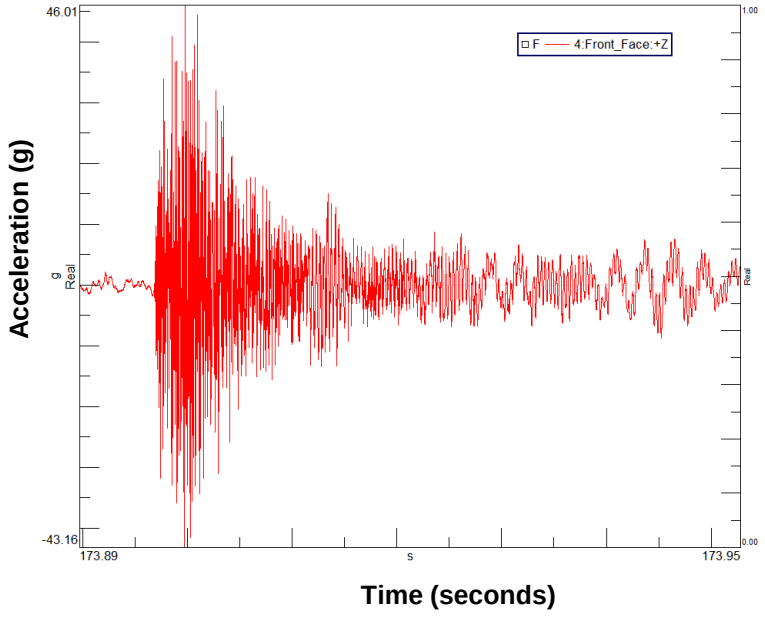
Shock Event Response at CG and Front Face

- **Ydir Input -6dB Random**
- **Response at CG accelerometer and Front Face accelerometer**

CG Accelerometer

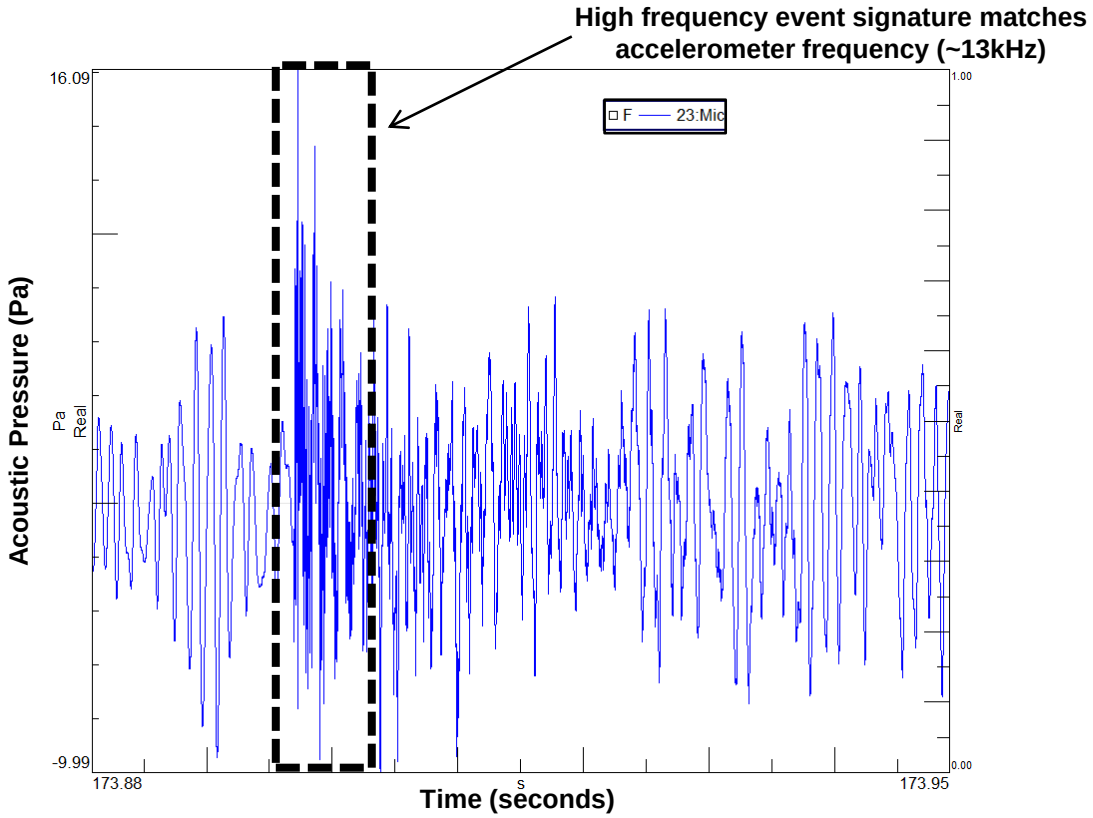


Front Face Accelerometer



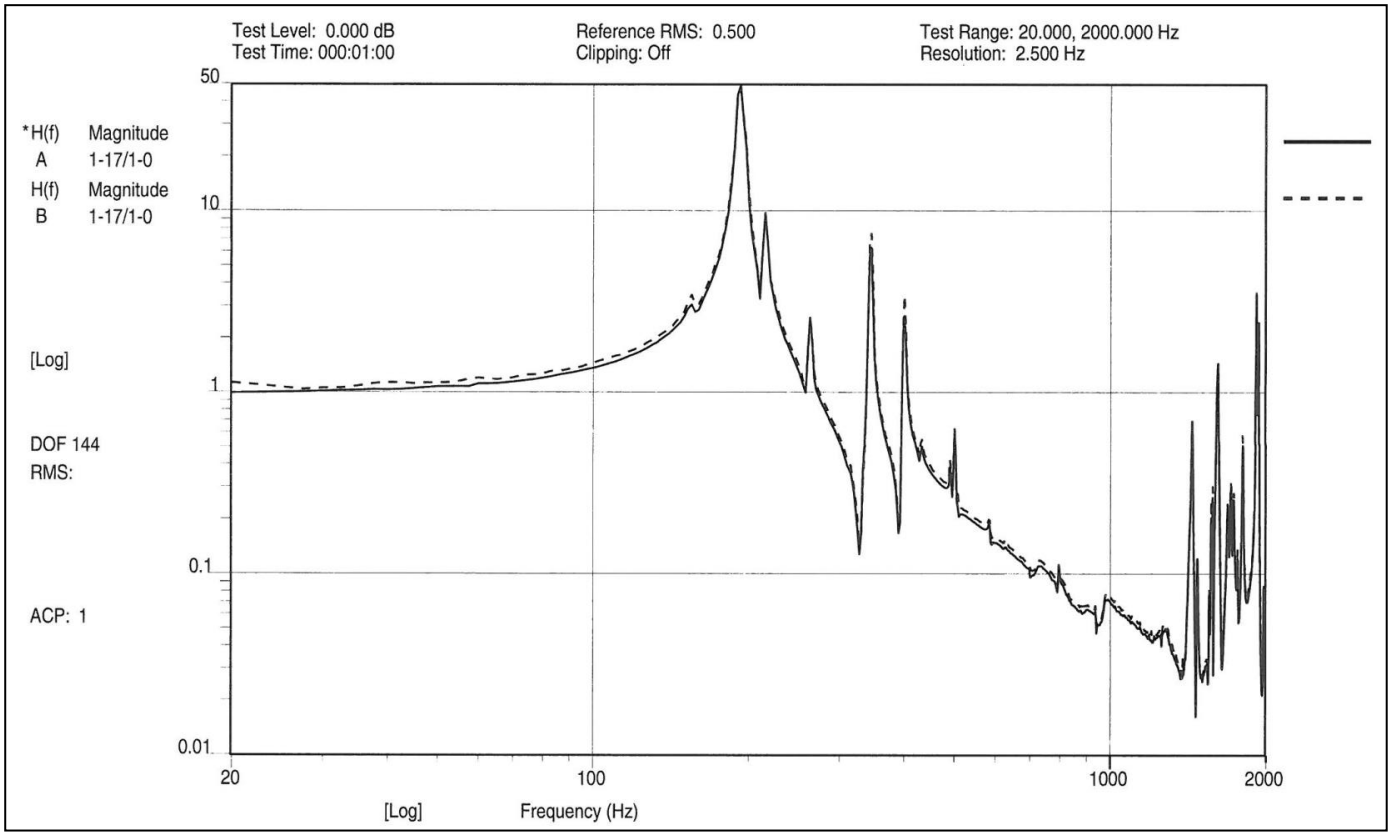
Shock Event Microphone Response

- **Input -6dB Random**
- **Response on microphone normal to bottom flexure (channel 21)**



Pre and Post White Noise Comparison

Resonant frequencies and damping are unchanged after the shock event during vibration at -6dB



Post Vibration Test Inspection

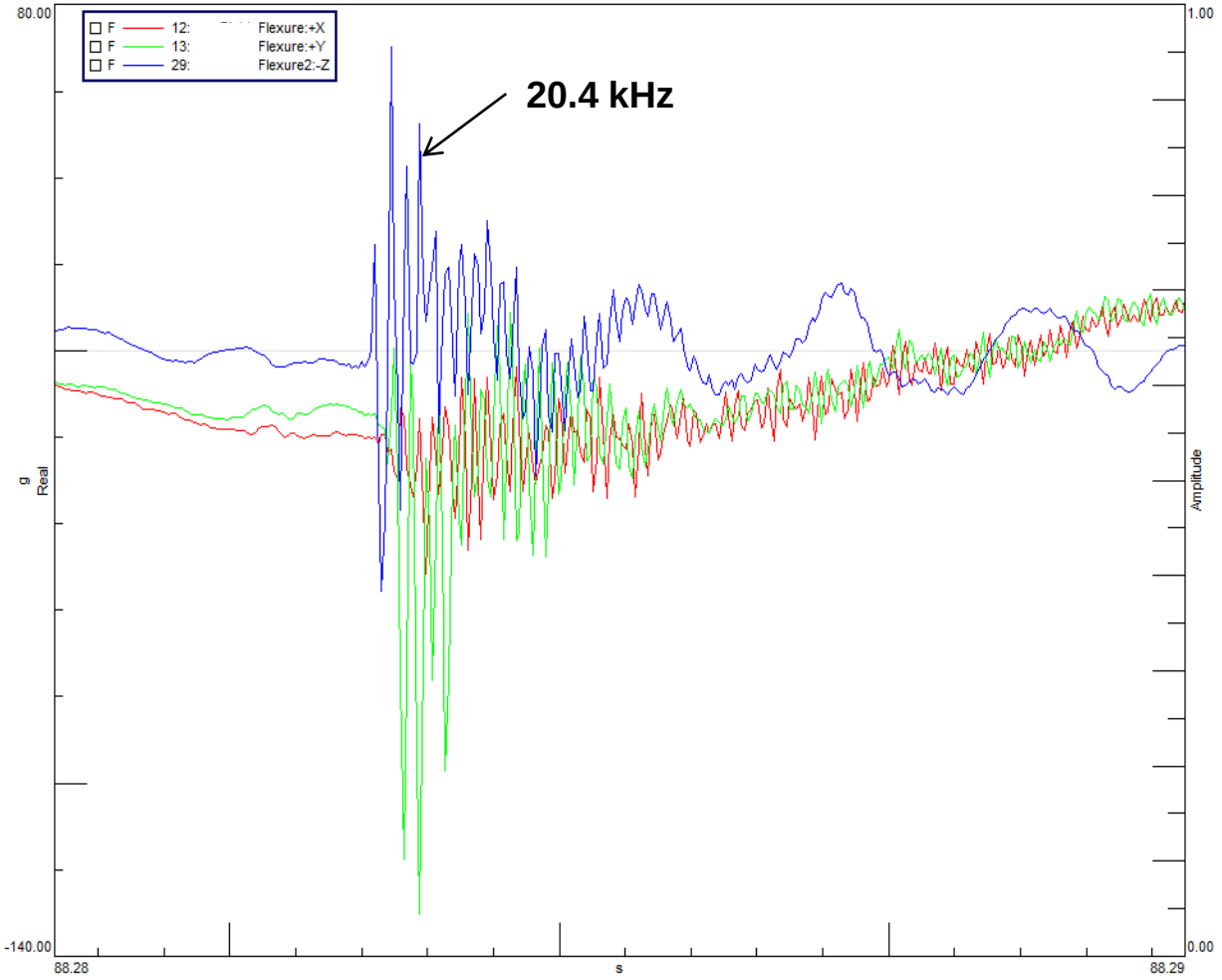
- **No decisive macro-level scratching/chipping at interface of tooling balls or flexure**
- **No noticeable fractures on flexure staking**

Solution

- System already in final configuration
- Not realistic to replace flexures, but needed to fix rotational stiffness
- Reduced shock down to acceptable levels by stiffening flexures using Constrained Damping Layer

Shock Event

Shock on Flexure



Summary

- Need to monitor boundary conditions
- Be aware of modeled stiffness vs actual stiffness
- Understand possible responses beyond 2kHz